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(54) **Vacuum cleaner**

(57) A suction nozzle housing 101 of an upright-type vacuum cleaner has a motor-driven, rotary brush assembly 112 comprising members 113, 114 mounted on bearings 127, 129 therein, said members being located above suction openings 133, 134 in chambers 135, 136 communicating with suction duct 200. Such an arrangement is designed to facilitate cleaning of floor areas adjacent to walls and corners of rooms. The housing may also be provided with a groove 140, flexible elements 143, and a pedal-operated brush assembly 153.

FIG. 4

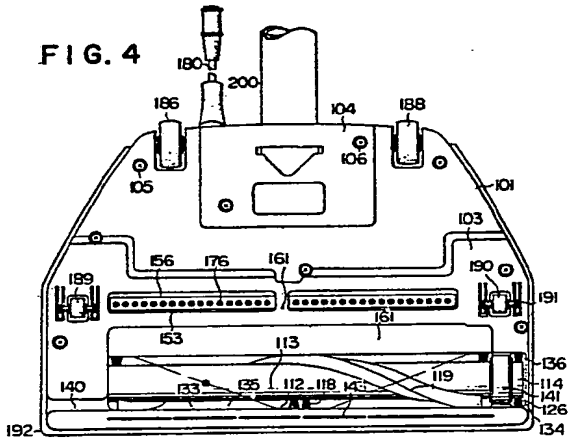

FIG. 5

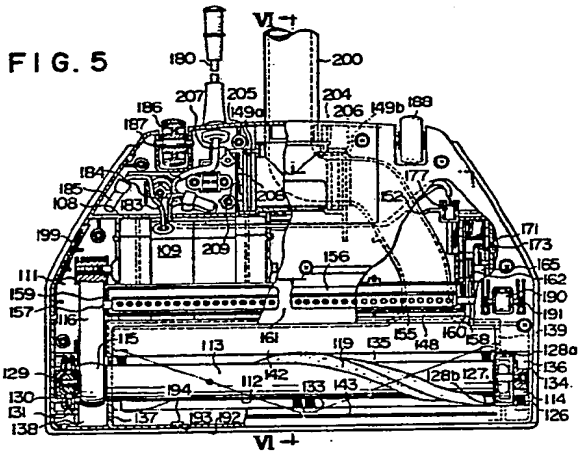

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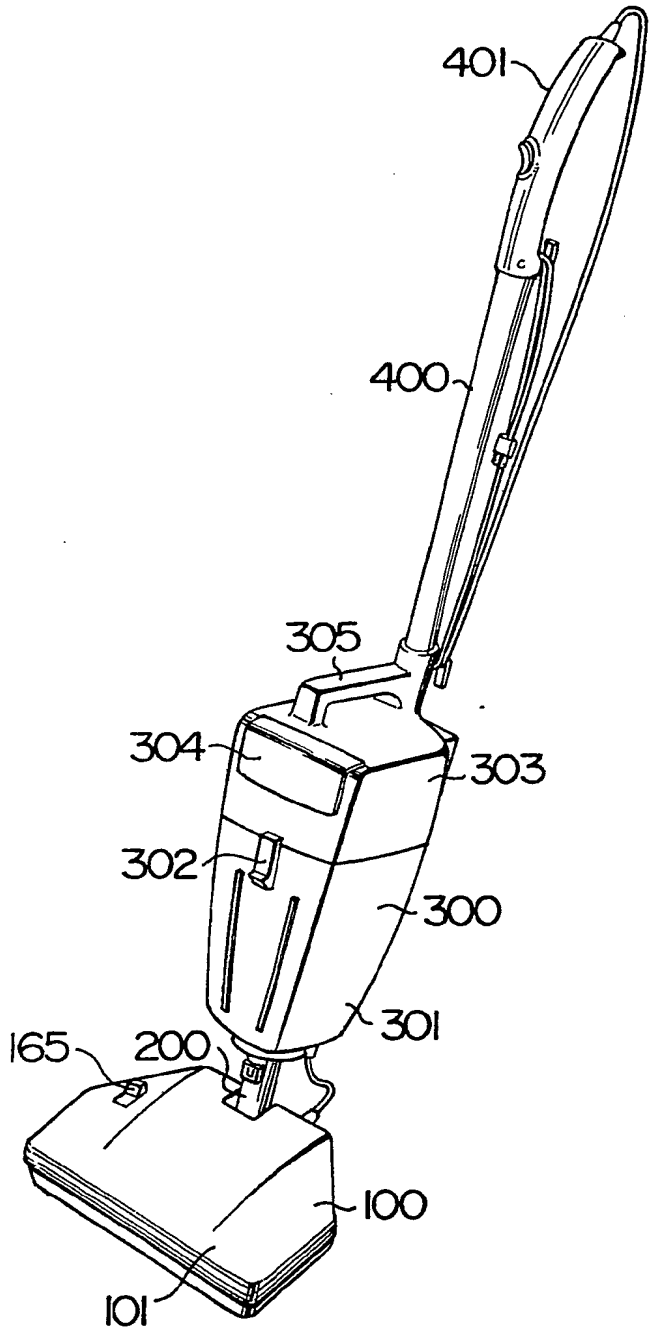
FIG. 1



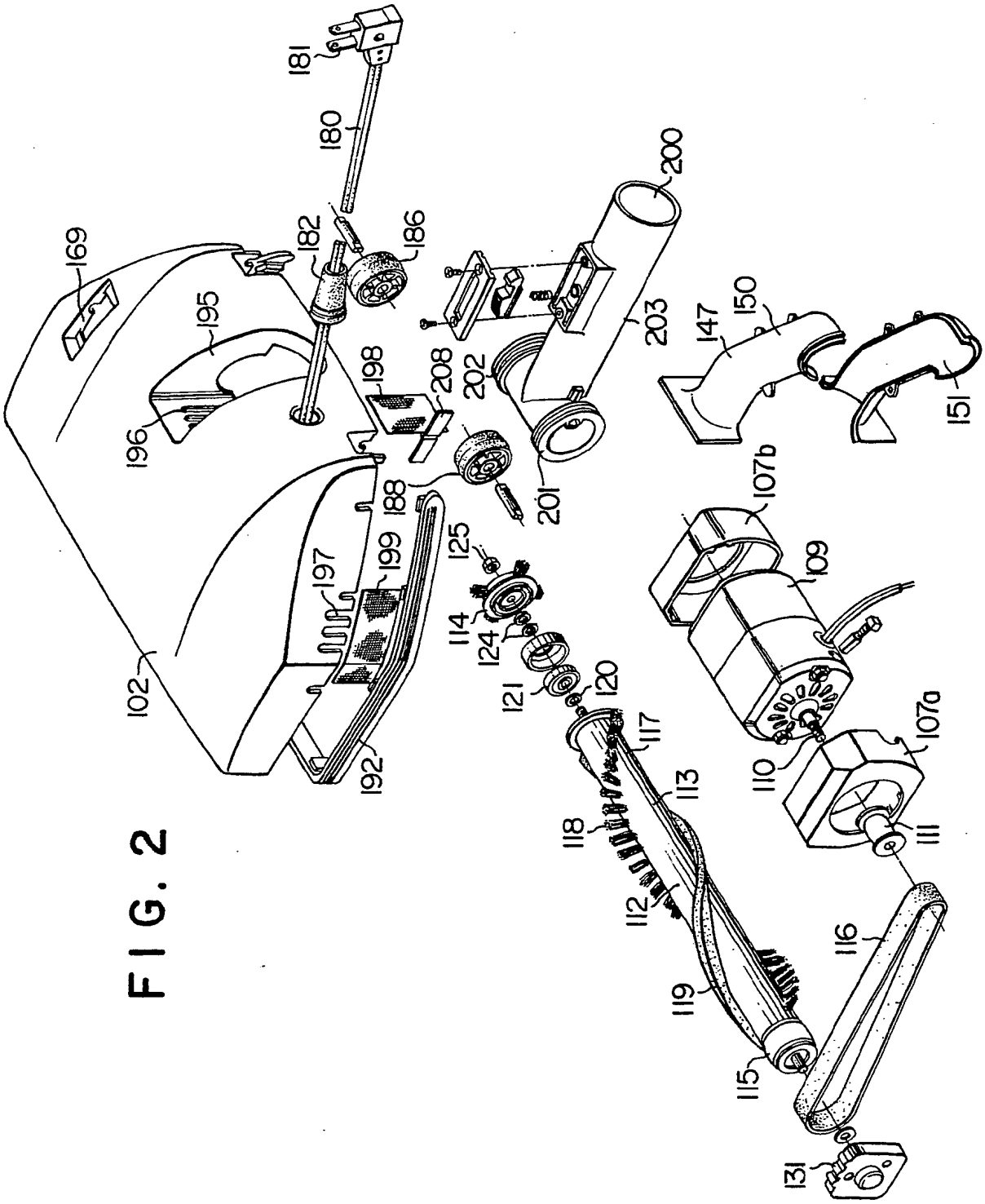


FIG. 2

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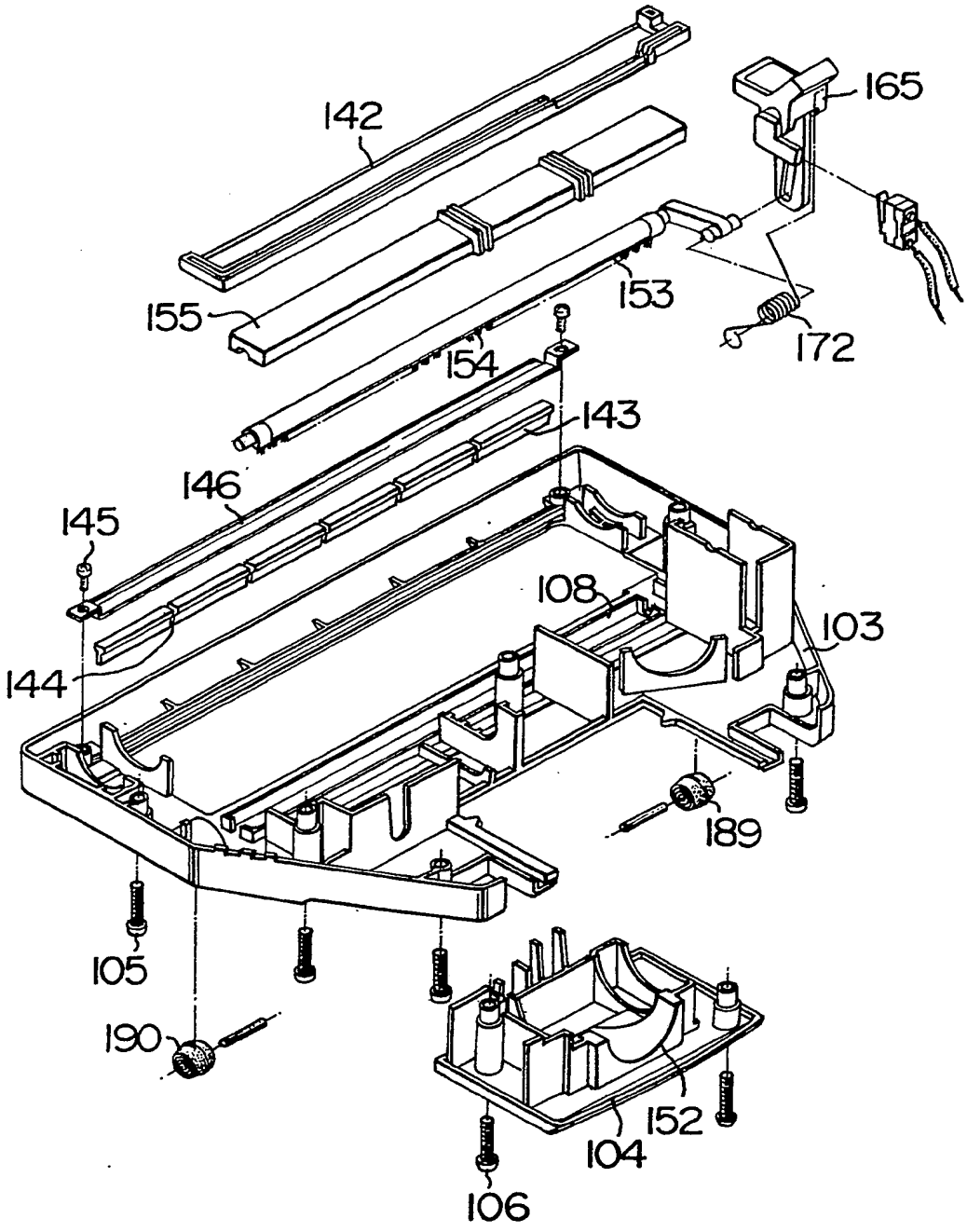
FIG. 3



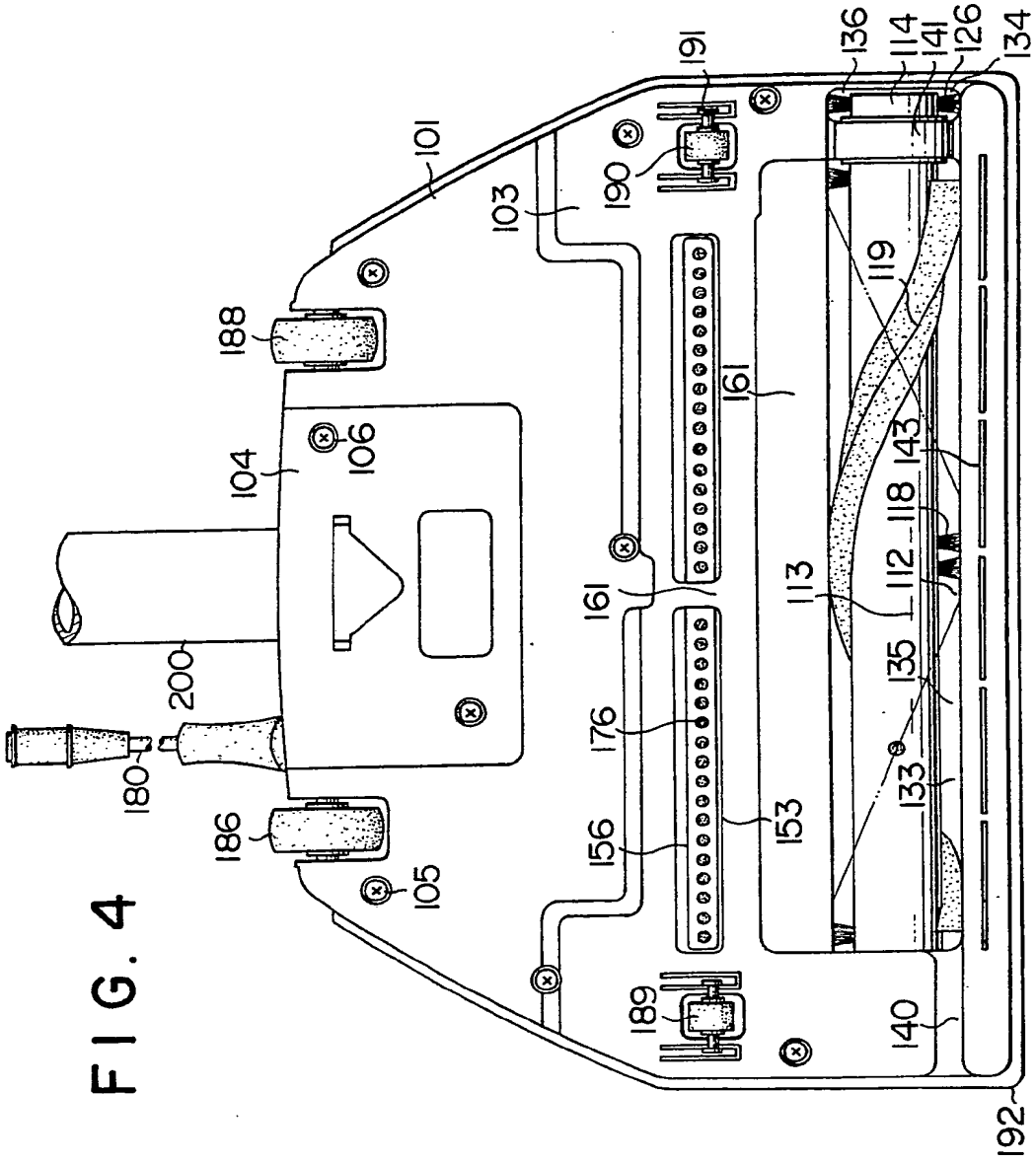


FIG. 4

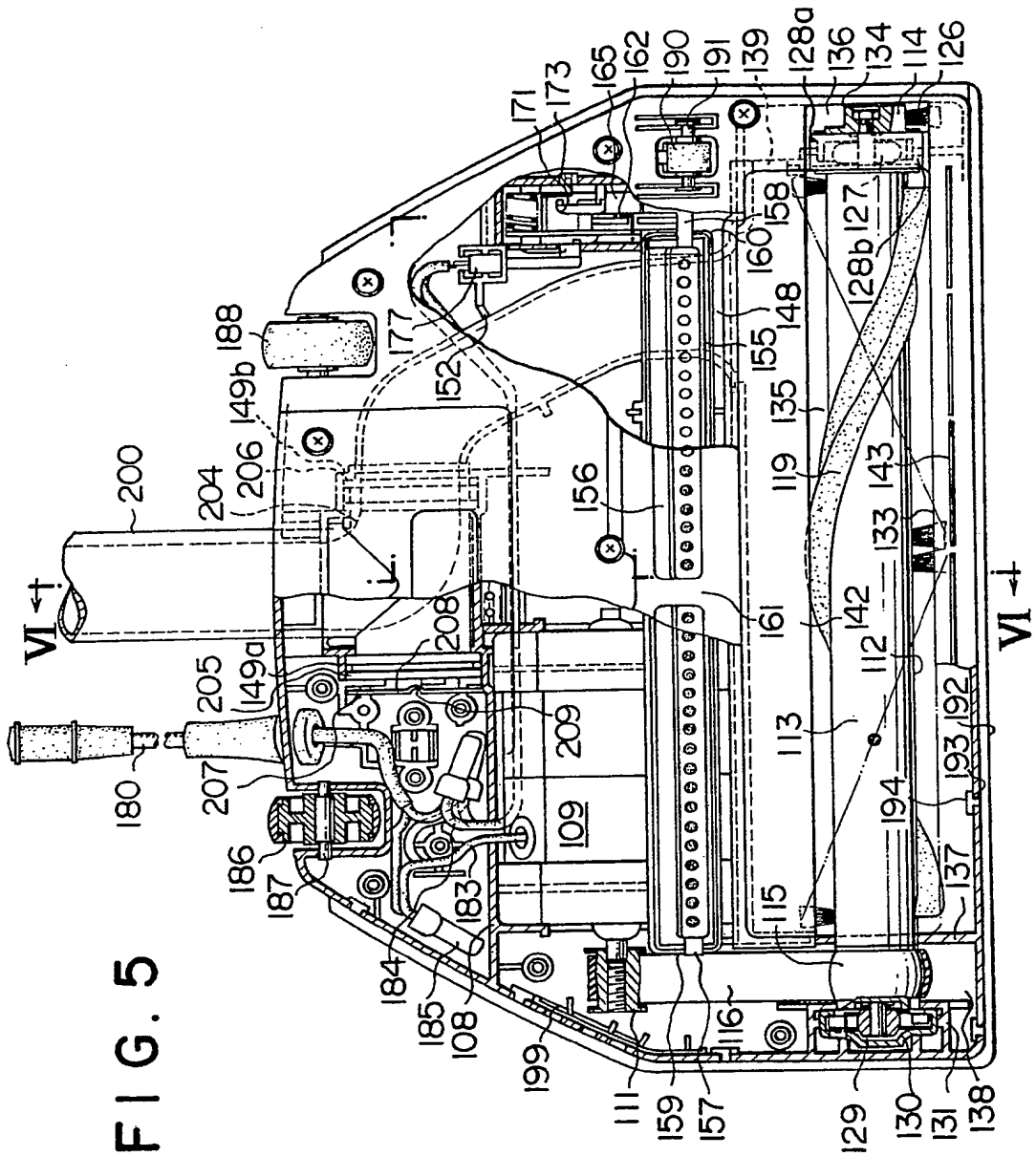


FIG. 5

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FIG. 6

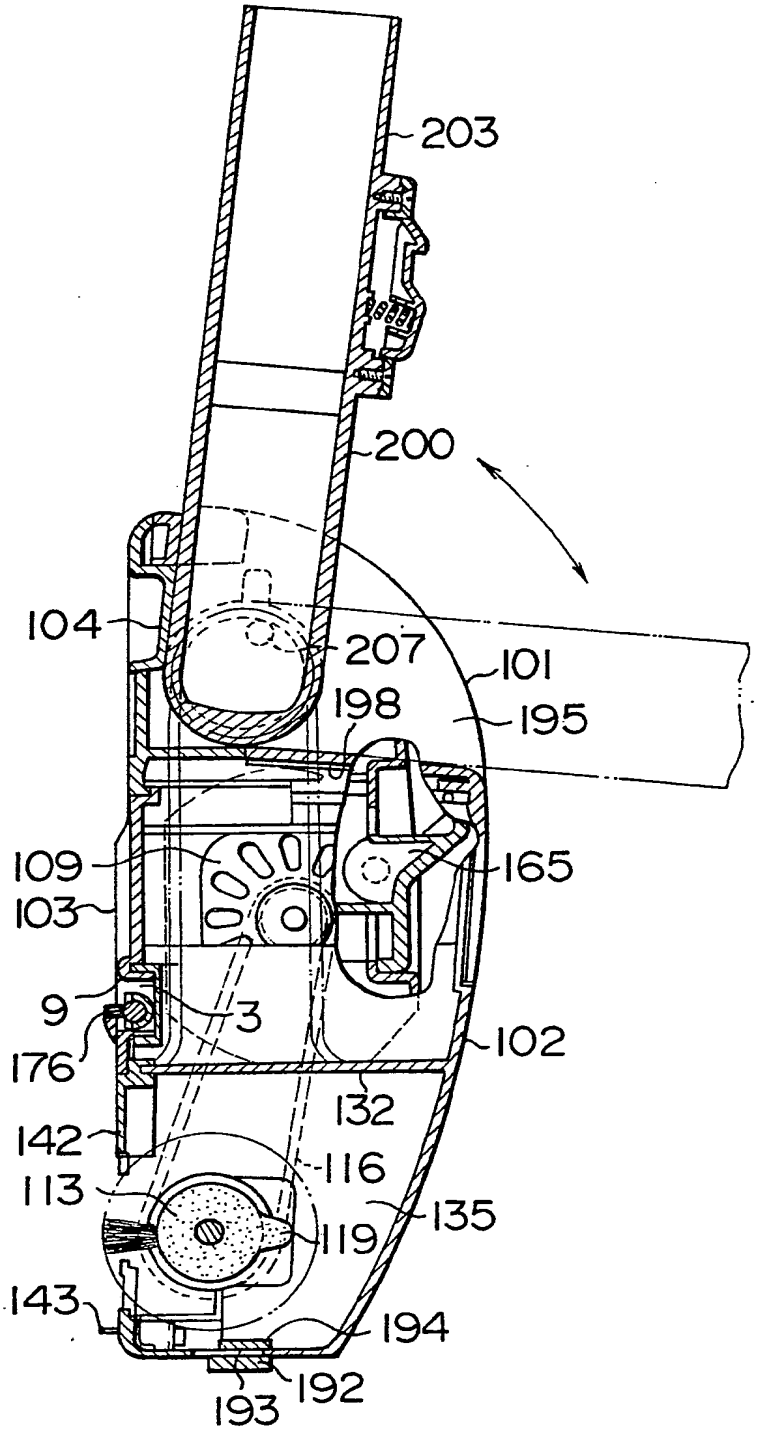


FIG. 7

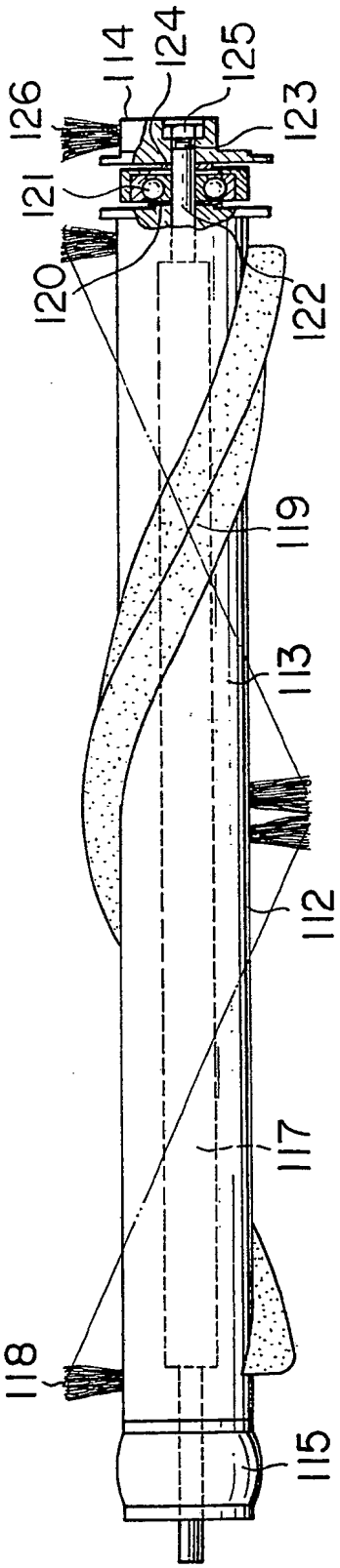


FIG. 9

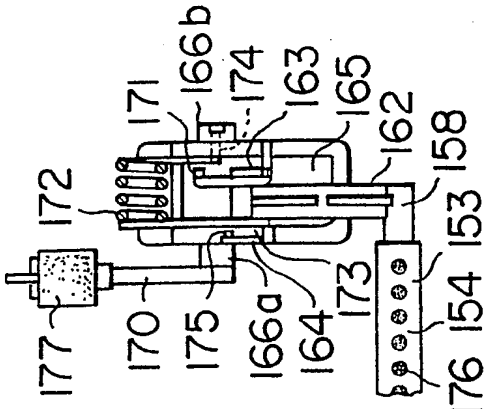


FIG. 8

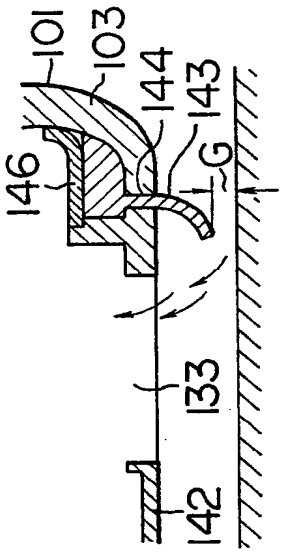


FIG. 10

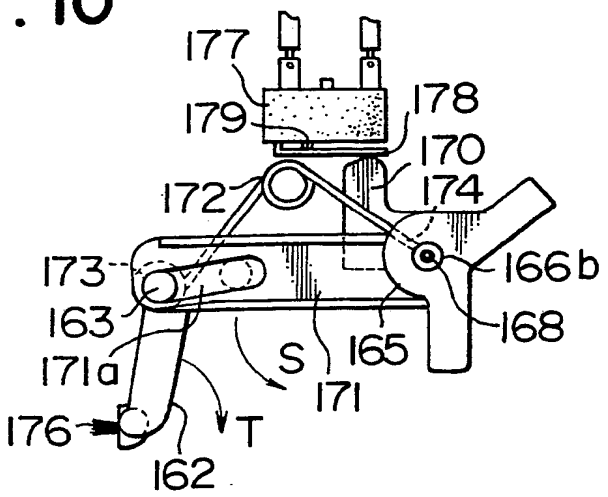


FIG. 11

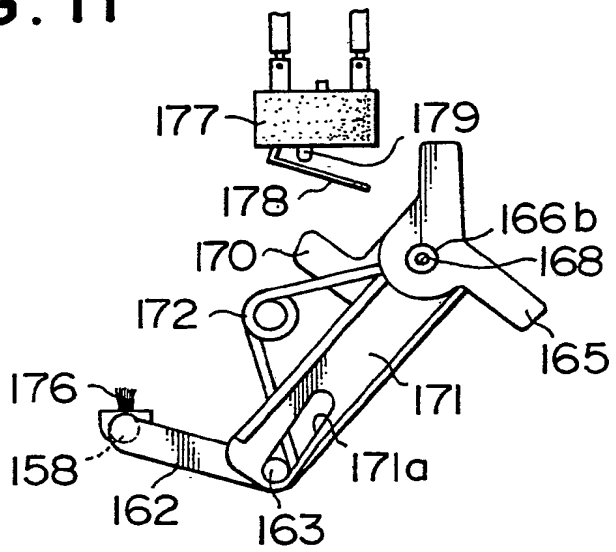
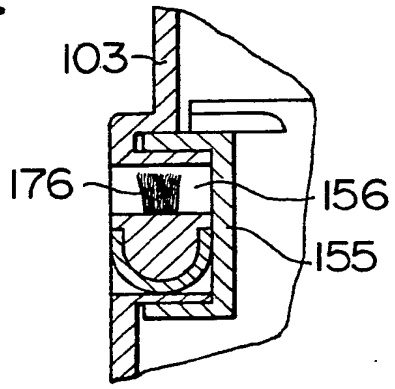


FIG. 12



SPECIFICATION

An inhaling unit for an electrically-operated vacuum cleaner

The present invention relates to an inhaling unit for an electrically-operated vacuum cleaner, more particularly an inhaling unit in such a vacuum cleaner which is useful for sweeping carpets.

Vacuum cleaners having inhaling units for brushing away dust on carpets are disclosed in U.S. Patent Nos. 3,188,681 and 3,199,138.

The vacuum cleaner of this type includes main body case having a pipe-like handle which is mounted on the upper portion thereof, a main cleaner unit comprising a unit body case with an electric blower contained therein and a dust case attached to the body case. The inhaling unit is connected with the inlet portion of the dust case. The inhaling unit includes a rotary brush assembly which is located in an inhaling aperture in the forward portion of the bottom of the inhaling unit. The rotary brush assembly includes a brush body and a beater, and is rotated by means of a driving motor which is incorporated in the inhaling unit. The beater serves to beat and drive out dust including waste threads, fallen hairs or the like which have become tangled with the yarns of carpets, and at the same time the brush body operates to sweep the driven-out dust away from the carpets. The swept dust is inhaled and collected into the dust case of the main cleaner unit through a dust passage in the inhaling unit.

In the inhaling unit of the prior art vacuum cleaner, however, the rotary brush assembly has its length substantially smaller than the width of the inhaling unit, and yet is positioned within the inhaling unit substantially at the central portion thereof. Therefore, the rotary brush assembly of the prior art inhaling unit is inoperative for sweeping at or near the sides thereof so that the dust including waste threads and fallen hairs cannot be removed from the carpets at corners or in the vicinity of walls of a room.

It is an object of the present invention to provide an inhaling unit for an electrically-operated vacuum cleaner in which the rotary brush assembly thereof can sweep dust away at the side of the inhaling unit.

Another object of the present invention is to provide an inhaling unit for an electrically-operated vacuum cleaner in which the dust swept away by the rotary brush assembly at the sides of the inhaling unit can be smoothly conducted into the inhaling unit.

Still another object of the present invention is provide an inhaling unit for an electrically-operated vacuum cleaner, which can level inhaling forces influenced by the velocities of inhaled air so that the inhaling forces will be prevented from decreasing, particularly, at low rate of flow in the inhaled air.

Further object of the present invention is to provide an inhaling unit for an electrically-operated vacuum cleaner which can sweep smooth surfaces of floors, straw matting and the like only by use of inhaled air without actuating the rotary brush assembly.

The present invention provides an inhaling unit for an electrically-operated vacuum cleaner comprising a main body unit, said inhaling unit including an inhaling body which has an inhaling aperture formed in the bottom of said inhaling body at the forward portion thereof and an electric motor incorporated into said inhaling body, a rotary brush chamber formed in said inhaling body downstream of said inhaling aperture to communicate with said inhaling aperture, a main brush member disposed within said rotary brush chamber and supported rotatably at each end by means of a bearing element, said main brush member being rotated by said electric motor and including a main brush body and a beater, a connecting tube mounted rotatably on the rearward portion of said inhaling body for joining said inhaling body with said main body unit, and a duct in said inhaling body for connecting the induction port of said rotary brush chamber with an inhaling port of said connecting tube, characterized in that said inhaling unit comprises an auxiliary inhaling aperture formed in said forward portion of said inhaling body at a location adjacent to the outside of one of said bearings which rotatably support said main brush member, an auxiliary brush chamber formed in said forward portion of said inhaling body and having an induction port which communicates with an induction port in said duct downstream of said auxiliary inhaling aperture, and an auxiliary brush member disposed within said auxiliary brush chamber to rotate together with said main brush member.

The present invention will now be described by way of example in connection with the accompanying drawings in which:

Figure 1 is a perspective view of an electrically-operated vacuum cleaner for carpets, provided with an inhaling unit of rotary brush type which is an embodiment of the present invention;

Figure 2 is an exploded view of the upper structure of the inhaling unit shown in Figure 1;

Figure 3 is an exploded view of the lower structure of the inhaling unit shown in Figure 1;

Figure 4 is a bottom view of the inhaling unit;

Figure 5 is a view illustrating, partly in section, the interior of the inhaling unit shown in Figure 2;

Figure 6 is a sectional view taken along a line VI-VI of Figure 5;

Figure 7 is a plan view showing, partly in section, the rotary brush assembly;

Figure 8 is a sectional view illustrating the operation of a flexible plate;

Figure 9 is a bottom view of a change lever;

Figure 10 is a side view showing the left side of the change lever shown in Figure 9;

Figure 11 is a view similar to Figure 10, showing the change lever in another position; and

Figure 12 is a vertical section of a floor brush which is in its retracted position.

Figure 1 illustrates an electrically-operated vacuum cleaner for carpets in which an inhaling unit 100 of rotary brush type is connected at the

rearward portion thereof with a main body unit 300 of the vacuum cleaner by means of a connecting tube 200 which is swingable backward and forward. With an upper portion of the main body unit 300 is connected a handle 400 in the form of a pipe which includes a grip 401.

The main body unit 300 of the vacuum cleaner includes a dust case 301 connected with the connecting tube 200 and a body case 303 on which the dust case 301 is detachably mounted by means of a clamp 302. The body case 303 is provided with a pocket 304 for receiving pins and coins which are picked up by an operator during the cleaning operation. The body case 303 further includes a handle 305 for carrying the main body unit 300.

The body case 303 has an electric blower incorporated thereinto, and the dust case 301 has a dust capsule, a filter member and a dust-removing device all of which are incorporated into the dust case 301.

The inhaling unit 100 according to the present invention will now be described in connection with Figures 2 and 3. The inhaling unit 100 comprises an inhaling body 101 which includes an upper case 102 having a top wall, side walls and front and back walls; a lower case 103 having a bottom wall, side walls and front and back walls; and a joint cover 104 mounted on the bottom of the lower case 103 for covering the connection of the connecting tube 200. The upper and lower cases 102, 103 and the cover 104 are made of a synthetic resin. The lower case 103 is mounted on the upper case 102 by means of screws 105, and also the joint cover 104 is mounted on the same by means of screws 106.

The inhaling unit 100 includes a motor 109 held in the inhaling body 101 inside the motor-supporting wall 108 through two rubber vibration insulators 107a and 107b. The motor 109 has a rotating shaft 110 to the tip of which a small pulley 111 is screwed.

A rotary brush assembly 112 is disposed in the forward portion of the inhaling body 101. The rotary brush assembly 112 comprises a main brush member 113 and an auxiliary brush member 114. The main brush member 113 includes a large pulley 115 formed at one end thereof. The pulley 115 is operably connected with the pulley 111 of the motor 109 by means of a belt 116 for transmitting power from the motor 109 to the rotary brush assembly 112.

In the illustrated embodiment, as shown in Figure 7, the main brush member 113 and pulley 115 are postformed on a brush member shaft 117 which is made of a synthetic resin. The main brush member 113 comprises a main brush 118 mounted thereon along a spiral path and a beater 119 in the form of a hard spiral ridge which is formed integrally on the surface of the main brush member 113 and protrudes outwardly therefrom. The brush shaft 117 protrudes outwardly from the other end of the main brush member 113 and is fitted with a ball bearing 121 through a washer 120 to form a bearing section. The brush shaft 117 has its tip end which extends outwardly through the ball bearing 121 and includes a stepped portion 122 and left-hand screw 123 formed therein. The auxiliary brush member 114 is clamped to the tip end of the brush shaft 117 through a washer 124 by screwing a left-hand threaded nut 125 to the left-hand screw 123 of the brush shaft 117. Thus, the auxiliary brush member 114 is positioned adjacent to the outside of one of the bearings which rotatably support the main brush member 118.

The auxiliary brush member 114 includes four of auxiliary brushes 126 mounted on the outer periphery thereof. The ball bearing 121 is enclosed by a vibration insulation cover 127 of rubber through which the ball bearing 121 is held by means of retaining ribs 128a and 128b of the inhaling body 101.

As shown in Figures 5 and 6, the other end of the brush shaft 117 which includes the large pulley 115 is supported by means of a plain bearing 129 which is made of oilless alloy and the like. The plain bearing 129 is held within a retaining case 131 of the inhaling body 101 through a bearing cover 130.

The main and auxiliary brush members 113 and 114 of the rotary brush assembly 112 are respectively disposed within a rotary brush chamber 135 and an auxiliary chamber 136. These chambers 135 and 136 are separated from the other portion of the inhaling body 101 by means of a partition wall 132 and communicate with an inhaling aperture 133 and an auxiliary inhaling aperture 134, respectively. The rotary brush chamber 135 is substantially separated from a belt chamber 138 by means of a sidewall 137 through which the main brush member 113 extends. The rotary brush chamber 135 is connected with the auxiliary brush chamber 136 through a connecting passage 139 located rearwardly of the retaining rib 128a.

As shown in Figure 4, the inhaling aperture 133 is formed at the side edge thereof with a dust inducting groove 140 which has its bottom positioned inwardly from the forward portion of the bottom of the inhaling body 101. The bottom of the inhaling body 101 also includes a bridge portion 141 which is located between the inhaling aperture 133 and auxiliary inhaling aperture 134 and depressed inwardly as in the dust inducting groove 140.

A protection plate 142 is mounted on the bottom face of the inhaling body 101 to form a rear edge of the inhaling aperture 133 and positioned substantially to cover the rearward portion of the inhaling aperture 133. The protection plate 142 is made of a flexible and resilient material so that an operator will not be subjected to injuries even when the operator's fingers are accidentally positioned within the rotary brush chamber 135 between the beater 119 of the rotating brush member 112 and the rearward edge of the inhaling aperture 133.

Flexible sheets 143 (six shown in Figure 4) are mounted on the foremost portion of the bottom of

ther inhaling body 101 to protrude downwardly in the front of the inhaling aperture 133, and positioned relative to one another at regular intervals substantially throughout the width of the inhaling aperture 133 such that small gaps will be remained between each adjacent flexible sheets 143. When the inhaling unit 100 is placed on a floor, the flexible sheets 143 is in contact with the surface of the floor so that air flowing rearwardly into the inhaling aperture 133 through a clearance between the forward edge of the inhaling aperture 133 and the surface of the floor will be controlled by the flexible sheets 143 to adjust the velocity of air at the inhaling aperture 133 in a relatively large rate of flow as shown by arrows in Figure 8, the flexible sheets 143 is shifted upwardly in a corresponding rate of lift to increase a clearance *G* between the flexible sheets 143 and the floor so that the above large rate of flow will be assured to decrease the velocity of air at the inhaling aperture 133. When the flow of air is relatively small at the inhaling aperture 133, the flexible sheets 143 is shifted upwardly in a smaller rate of lift to hold the clearance *G* smaller or in contact with the floor so that the air will be passed only through the gaps between the flexible sheets 143 to increase the velocity of air. Thus, inhaling forces relating to the velocity of air are levelled in the whole range of flows so that the inhaling force will be prevented from decreasing, particularly, at low rate of flow.

Each of the flexible sheets 143 includes a base located within the lower case 103 of the inhaling body 101 at the forward edge thereof and an actuating plate protruding downwardly from the bottom of the lower case 103 through a slit 144 which is formed in the lower case 103. The six flexible sheets 143 are simultaneously held within the lower case 103 by means of a hold-down plat 146 which is in turn clamped to the lower case 103 by means of screws 145. The total width of five gaps between the flexible sheets 143 is in the range between 2% and 5% of the width of the inhaling aperture 133.

The rotary brush chamber 134 includes an inducting port 148 formed therein adjacent to the auxiliary brush chamber 136. The inducting port 148 is connected with the intake port of the connecting tube 200 which is pivoted to the rearward portion of the inhaling body 101, through a duct 147 in the form of a cylindrical pipe. The duct 147 is engaged at the respective ends by the partition wall 132 and a retaining wall 149b for the connecting tube. Thus, the inducting port 148 of the duct 147 is positioned at a location adjacent to the connecting passage 139 between the rotary brush chamber 135 and auxiliary brush chamber 136 and lying towards the center of the inhaling.

As shown in Figure 2, the duct 147 consists of an upper half 150 made of synthetic resin in a semi-cylindrical configuration and a lower half 151 made of the same material in a symmetrical configuration relative to the upper half 150. The connection between the upper and lower halves is provided with a socket-spigot joint. The duct 147 is held between the upper and lower cases 102 and 103 when they are connected with each other. The central portion of the duct 147 is supported by means of a rib 152. Figure 5 indicates the duct 147 by a phantom line.

A floor brush assembly 153 is located within a floor-brush receiving portion 156 which is defined by a brush cover 155 and a brush wall of the lower case 103. The floor brush assembly 153 includes a plurality of brush bundles 154, and is supported at the opposite end shaft portions 157 and 158 by means of bearing portions 159 and 160 in the floor-brush receiving portion 156. The floor-brush receiving portion 156 includes a reinforcing bridge 161 formed therein substantially at the center thereof. The end shaft portion 158 extends outwardly through the side of the floor-brush receiving portion 156 with the tip thereof being formed integrally with an arm 162.

As seen from Figures 5 and 9, the arm 162 includes an intergral cross bar formed therein at the tip thereof to form a T-shaped configuration, the cross bar consisting of an outer sliding shaft 163 and an inner spring-engaging shaft 164. A change lever 165 is rotatably supported by the lever partition of the inhaling body 101 which encloses the change lever section. The change lever 165 includes lever shafts 166a and 166b formed therein at the opposite sides thereof which shafts are received in the respective lever bearings 167a and 167b in the above lever partition. The change lever 165 further includes a pedal portion protruding outwardly from the top face of the inhaling body 101 through an aperture 169 which is formed in the inhaling body 101. The lever shaft 166b has a spring retaining bore extending therethrough along its longitudinal center line while the opposite lever shaft 166a has a switch lever 170 formed integrally therein at the tip thereof to form substantially a L-shaped configuration. The change lever 165 further includes a brush actuating lever 171 formed therein at a substantial central portion of the bottom thereof integrally of the pedal portion. The brush actuating lever 171 includes a sliding slot 171a formed therein at the tip portion thereof. The sliding slot 171a has its width slightly larger than the diameter of the sliding shaft 163 in the floor brush assembly 153. The sliding shaft 163 is engaged by the sliding slot 171a, and reciprocated within the sliding slot 171a by operating the pedal.

As seen from Figure 9, a lever spring 172 in the form of a coil spring is provided with a substantially annular end portion 173 and a L-shaped end portion 174. The substantially annular end portion 173 is fitted over the outer periphery of the spring engaging shaft 164 of the floor brush assembly 153 which has a retaining projection 175 while the L-shaped end portion 174 is inserted at its free extremity into the spring retaining bore formed in the lever shaft 166b of the change lever 165. The lever spring

172a serves to urge the arm 162 of the floor brush assembly 165 toward the lower end of the sliding slot 171a between the change lever 165 and the floor brush assembly 153. The opposite ends of the lever spring 172 are rotatable in the spring-engaging shaft 164 and spring-retaining hole 169, respectively.

In such an arrangement, when the pedal is in a "floor, straw-matting position" as shown in Figures 9 and 10, the brush actuating lever 171 is positioned in a downward direction. The arm 162 of the floor brush assembly 153 which engages with the sliding slot 171a at the sliding shaft 163 thereof is substantially in a horizontal position so that the brush portion 154 will be maintained substantially in a downward direction to protrude downwardly the bristle 176 of the brush portion 154 beyond the bottom of the inhaling body 101. These bristles 176 serves to collect and scrape dust on the floor or straw matting.

When the pedal portion is moved to a "carpet position" from the "floor, straw-matting position" as shown in Figure 10, the brush actuating lever 171 is rotated forwardly and upwardly around the lever shafts 166a and 166b as shown by an arrow *S* in Figure 10. By the rotation of the brush actuating lever 171, the sliding shaft 163 is moved upwardly within the sliding slot 171a against the influence of the lever spring 172 with the opposite ends thereof being approached to each other. Accordingly, the arm 162 associated is rotated upwardly around the shaft 158 as shown by an arrow *T* in Figure 10. At the same time, the brush portion 154 is rotated rearwardly about the shaft portions 157 and 158.

In a substantially intermediate position from the "floor, straw-matting position" to the "carpet position" of the pedal portion, the sliding shaft 163 is positioned in the sliding slot 171a at the highest location. As the brush actuating lever 171 is further rotated forwardly and upwardly, the sliding shaft 163 is then moved back downwardly in the sliding slot 171a so as to further rotate the arm 162 in the forward direction. At this time, the lever spring 172 is oriented in its expansion direction so that the movements of the sliding shaft 163 and brush actuating lever 171 will be assisted by the influence of the spring 172. In other words, the lever spring 172 will pass through a dead point in the substantially intermediate position of the pedal portion 168. This provides a snap motion to the pedal portion.

When the pedal portion is finally positioned at the carpet position, the sliding shaft 162 is located back in the lowermost end of the sliding slot 171a, the arm 162 is in its substantially vertical position, and the associated brush portion 154 is held in such a position that it is turned in a rearward and transverse direction by slightly more than 90 degrees of angle. Therefore, the floor brush 176 is oriented rearwardly so that it will be retracted inwardly from the bottom of the inhaling body 101 and housed in the floor brush receiving portion 156. This means that the floor brush 176 will be prevented from engaging with the carpets to freely slide the inhaling unit 100 on the carpets.

Furthermore, the side of the brush portion 154 is flush with the bottom face of the inhaling body 101 which encloses the brush receiving portion 156, in the carpet position of the pedal. The inhaling body 101 is therefore prevented substantially from sinking in the carpets so that that operating force of the vacuum cleaner will be decreased on the carpets.

The switch lever 170 is rotated around the lever shafts 166a and 166b upon the change motion of the pedal portion. When the pedal portion is in the floor, straw-matting position as shown in Figure 10, the extremity of the switch lever 170 engages with an actuator plate 178 of a microswitch 177 which has a normally-closed contact. By engaging the switch lever 170 with the actuator plate 178, a switch button 179 in the microswitch 177 is pushed inwardly to open a circuit for the motor 109 which is in turn stopped to cease the rotation of the rotary brush assembly 112. It is consequently appreciated that this arrangement will prevent the rotary and auxiliary brush assemblies 112 and 126 from spattering the dust on the floor and straw matting or from damaging the floor and straw matting.

When the pedal portion 168 is in the carpet position, the switch lever 170 is separated away from the actuator plate 178 so that the switch button 179 is positioned in its free position to close the motor circuit, thereby actuating the motor 109 to rotate the rotary brush assembly 112. Accordingly, the carpet will be swept by the main brush 118, the auxiliary brush 126 and the beater 119 so that the dust on the carpet can be beaten and driven out. The microswitch 177 is fixed to a switch case therein.

The connecting tube 200 is made of a synthetic resin material in the form of a substantially T-shaped pipe which includes two cylindrical pivot portions 201 and 202 extending transversely in the opposite directions and a cylindrical communicating pipe 203 connected perpendicularly to the connection between the pivot portions 201 and 202. The communicating pipe 203 communicates with the induction end of the pivot portion 202 through an elbow pipe portion 204 which is formed in the pivot portion 202. The pivot portions 201 and 202 are provided with sliding flanges 205 and 206 formed on the outer peripheries of the pivot portions, respectively. The sliding flanges 205 and 206 are rotatably mounted in the respective retaining walls 149a and 149b of the inhaling body 101 and serve as stoppers for the connecting tube 200. Thus, the connecting tube 200 is mounted on the inhaling body 101 in such a manner that the connecting tube 200 is swingable relative to the inhaling body 101 in its forward and rearward directions as shown by an arrow in Figure 6.

The end of the pivot portion 202 adjacent to the inhaling aperture 148 is engaged by the corresponding end of the duct 147 at the retaining wall 149b so that these ends will be slided relative

to each other as the connecting tube 200 is swung.

The other pivot portion 201 includes a snap-action projection 207 formed therein at the end thereof which serves to prevent the connecting tube 200 from freely shifting by urging a corresponding projection 209 of a snap-action leaf spring 208 to pass therebeyond as the connecting tube 200 is swung.

A lead 180 from a source of electricity extends into the inhaling body 101 through a bushing 182 in the rearward wall thereof. The lead 180 includes a plug 181 mounted thereon at the extremity thereof. The leads 180 is connected with a lead 183 from the motor 109 and a lead 184 from the microswitch 170 through connectors 185.

Wheels 186 and 188 are mounted on wheel-mounting walls which are defined by the upper and lower cases 102 and 103. Each of the wheels 186 and 188 is provided with an axle 187 connected with the corresponding wheel-mounting wall. Moreover, small wheels 189 and 190 are mounted within a wheel cover formed integrally in the lower case 103 in such a manner that these small wheels can be rotated around axles 191.

As seen from Figures 2 and 6, bumpers 192 are mounted on the front and side faces of the inhaling body 101 by inserting stoppers 194 into a plurality of grooves 193 which are formed in the upper case 102 of the inhaling body 101, and holding between the upper and lower cases 102 and 103.

The motor 109 includes a cooling fan incorporated thereinto which is adapted to induct ambient air through induction ports 196 in the forward wall of a joint-mounting recess 195 into the interior of the inhaling body 101 and through intake ports in the motor 109 into the interior thereof to cool the motor itself. After the air has cooled the motor 109, it is exhausted outside from the exhaust side ports 197 of the inhaling body 101 through discharge ports which are formed in the motor adjacent to the pulley 111 as the intake ports. Filters 198 and 199 are disposed in the induction and exhaust ports 196 and 197 for preventing any foreign matter from passing into the motor.

In operation, the plug 181 in the lead 180 is electrically connected with, for example, the outlet of the main cleaner unit 300, and the connecting tube 200 is mechanically connected directly with the main cleaner unit 300 through the clamp means or indirectly with the same through an extension tube (not shown). The main cleaner unit 300 is thereafter switched on so that air containing dust materials will be inhaled into the inhaling body 101 through the inhaling aperture 133 and auxiliary inhaling aperture 134, and passed into the duct 147 through the induction port 148 via the rotary brush and auxiliary brush chambers 135, 136, and therefrom into the inhaling port of the connecting tube 200. The air is thereafter passed into the main cleaner unit 300 through the elbow tube 204 and communicating pipe 203 of the connecting tube 200 and collected in the dust case 301.

When it is desired to clean carpets, the pedal of the change lever 165 is moved into the carpet position. The switch lever 170 is therefore separated away from the actuator 178 of the microswitch 177 to close the circuit for the motor 109 so that the latter will be energized to rotate the rotary brush assembly 112 through the belt 116. Consequently, the carpet is beaten by the beater 119 of the main brush member 113 to drive out the dust materials from the carpet and then swept by the main and auxiliary brushes 118, 126. At this time, the brush elements 154 of the floor brush assembly 153 is rearwardly turned and the floor brush 176 is retracted in the floor-brush receiving portion 156. Therefore, the floor brush 176 will be prevented from biting into the carpet to provide a smooth operation of the vacuum cleaner.

When it is desired to sweep floors or straw matting, the pedal of the change lever 165 is moved into the floor, straw-matting position. The switch lever 170 then pushes the actuator plate 178 of the microswitch 177 in the inward direction to open the motor circuit so that the motor 109 will be de-energized. The rotary brush assembly 112 is then inoperative so that the dust materials will be picked up merely by the inhaled air for preventing the main and auxiliary brushes 118, 126 of the rotary brush assembly from spattering the dust on the floor or straw matting. Moreover, the floor or straw matting will not be damaged by the main brush 118, the beater 119 and the auxiliary brush 126 which are rotated at high velocity. At this time, the brush elements 154 of the floor brush assembly 153 is downwardly turned in relation to the movement of the change lever 165. The floor brush is protruded downwardly from the floor-brush receiving portion 156. When the inhaling unit 100 is operated on the floor, the floor brush 176 softly sweeps the surface of the floor to scrape the dust materials which have sticked to the floor or positioned in any recess on the floor.

In the above illustrated embodiment of the present invention, the inhaling unit 100 includes the auxiliary brush assembly which is mounted therein outside one of the ball bearings 121 for the main brush member 113 and positioned adjacent to the side wall of the inhaling body 101. Accordingly, the inhaling unit of the present invention can be effectively operated adjacent to the side edge thereof to sweep floor locations at the corners and adjacent to the walls of a room.

When the rotary brush assembly 112 with the main brush 118 and beater 119 is rotated clockwise as viewed in Figure 6, the main brush 118 serves as a certain type of axial fan so that the inhaled air will flow from the left hand to the right hand as viewed in Figure 5, that is, from the large pulley 115 to the auxiliary brush assembly 114. In addition to the axial flow of air caused in the rotary brush chamber 135, there is another

flow of air which is produced by the operation of the vacuum cleaner itself to pass through the induction port 148 of the duct 147 from the inhaling aperture 133. This additional air flow will assist the axial flow of air which is produced by the main brush 118 and beater 119. The dust materials inhaled through the inhaling aperture 133 ride on these axial flows of air which are produced by the rotation of the main brush 112 to flow toward the auxiliary brush assembly 114.

On the other hand, the auxiliary brush assembly of the present invention produces a further flow of air in the opposite direction relative to the above axial flows of air. The further flow passes into the rotary brush chamber 135 through the auxiliary inhaling aperture 134, auxiliary brush chamber 136 and communicating passage 139. Thus, on the way to the rotary brush chamber 135, the axial flow of air which is produced by the rotation of the main brush assembly 112 will collide with a portion of the flow of air which is produced by the operation of the vacuum cleaner itself to pass from the auxiliary inhaling aperture 134 through the auxiliary brush chamber 136 and the communicating passage 139. Since the axial flows from the respective main and auxilary brush assemblies 112, 114 are caused to collide with each other short of the bearing portion in the rotary brush chamber 135, they are decreased in velocity when caused to collide with the bearing portion. This means that the dust materials are effectively prevented from penetrating into the bearing portion, and the life thereof will be strengthened.

The plain bearing 129, which is located adjacent to the large pulley 115 of the rotary brush assembly 112, is also protected against damaging due to the inhaled dust materials since the plain bearing 129 is positioned upstream the axial flow of air.

Since the induction port 148 of the duct portion 147 between the rotary brush chamber 135 and the connecting tube 200 is provided adjacent to the auxiliary brush member, that flow of air that is inhaled through the auxiliary inhaling aperture 134 under the operation of the vacuum cleaner itself can be increased so that the dust materials picked up by the auxiliary brush 126 will be carried completely from the auxiliary brush chamber 126 and communicating passage 139 to the induction port 148 without falling on the floor.

Since the induction port 148 of the duct 147 is located in the communicating passage 139 adjacent to the rotary brush chamber 135, the velocity of flow in the duct 147 and communicating passage 139 can be increased so that the inhaled dust will not be remained in the communicating passage 139.

Since the flow produced by the rotation of the rotary brush assembly 112 is moved from the large pulley 115 to the auxiliary brush member 114, the flow rate is reduced in that portion of the inhaling aperture 133 adjacent to the large pulley 115 so that the dust materials picked up by the main brush 118 will not be remained in the other portion of the inhaling aperture 133 adjacent to the auxiliary brush member 114.

When the change lever 165 is shifted to stop the rotary brush assembly 112 so as to sweep the floor or straw matting merely by the stream of air, the corners of a room can be effectively cleaned by the vacuum cleaner of the present invention since the induction port 148 of the duct 147 is positioned adjacent to the auxiliary brush member 114 such that the inhaling efficiency in the side of the inhaling body 101 will be improved by the flow of air from the auxiliary inhaling aperture 134 of the auxiliary brush member 114.

Since the flexible sheets 143 is provided to downwardly protrude beyond the bottom of the inhaling body 101 at the foremost portion thereof, they are flexed up by the stream of air moving toward the inhaling aperture 133 to control a clearance between the flexible sheets and the floor. When the rate of flow at the inhaling aperture 133 is increased, the above clearance is also increased to assure the above increased flow rate so as to reduce the stream of air in velocity. When the rate of flow at the inhaling aperture 133 is decreased, the flexible sheets 143 are less flexed up to maintain the clearance smaller or to contact the flexible sheets with the floor so that the rate of flow will be decreased to increase the stream of air in velocity. Thus, inhaling forces relating to the velocities of flow can be levelled independently of the rate of flow so that the inhaling forces can be prevented from reducing, particularly, at low rate of flow.

It is to be understood from the above description that the present invention provides an electrically-operated vacuum cleaner comprising an inhaling unit which can effectively sweep floors and straw matting in the side portion of the inhaling unit itself and smoothly move the inhaled dust materials within the inhaling unit so that the corners and by-wall locations of a room can be effectively cleaned. This is because the inhaling body includes the auxiliary aperture and brush chamber formed therein adjacent to the outside of one of such bearings that rotatably support the main brush member including the main brush and beater, and the auxiliary brush member portioned within the auxiliary brush chamber and having the auxiliary brush which is rotated together with the main brush member.

CLAIMS

1. An inhaling unit for an electrically-operated vacuum cleaner having a main body unit, comprising an inhaling body which has an inhaling aperture formed in the bottom of said inhaling body at the forward portion thereof and an electric motor incorporated into said inhaling body, a rotary brush chamber formed in said inhaling body downstream of said inhaling aperture to communicate with said inhaling aperture, a main brush member disposed within said rotary brush chamber and supported rotatably at each end by means of a bearing element, said main brush member being rotated by said electric motor and

including a main brush and a beater, a connecting tube mounted rotatably on the rearward portion of said inhaling body for joining said inhaling body with said main body unit, and a duct in said inhaling body for connecting the induction port of said rotary brush chamber with the inhaling port of said connecting tube, characterized in that said inhaling unit comprises an auxiliary inhaling aperture formed in said forward portion of said inhaling body at a location adjacent to the outside of one of said bearings which rotatably support said main brush member, an auxiliary brush chamber formed in said forward portion of said inhaling body and having an induction port which communicates with an induction port in said duct downstream of said auxiliary inhaling aperture, and an auxiliary brush member disposed within said auxiliary brush chamber to rotate together with said main brush member.

2. The inhaling unit as defined in claim 1, characterized in that said auxiliary brush member is mounted on a brush member shaft which extends outwardly from said main brush member.

3. The inhaling unit as defined in claim 1, characterized in that the induction port of said duct adjacent to said main brush chamber is positioned at a location adjacent to said auxiliary brush member and lying towards the center of said inhaling body.

4. The inhaling unit as defined in claim 3, characterized in that the induction port of said duct is positioned, at a location adjacent to a communicating passage which connects said rotary brush chamber with said auxiliary brush chamber, and lying towards the center of said inhaling body.

5. The inhaling unit as defined in claim 1, characterized in that said inhaling unit further includes flexible sheets extending downwardly from the bottom of said inhaling body at a location before said inhaling aperture.

6. The inhaling unit as defined in claim 1, characterized in that said inhaling unit further includes a floor brush means mounted swingably within a floor-brush receiving portion which is formed in said inhaling body at the rearward portion of said inhaling aperture, and a change lever being located on the upper surface of said inhaling body and associated with said electric motor, said change lever being adapted to protrude said floor brush means from the bottom of said inhaling body or to retract the same into said inhaling body.

7. The inhaling unit as defined in claim 6, characterized in that said electric motor is stopped through the operation of said change lever not to rotate said main and auxiliary brush members when said floor brush means is protruded downwardly beyond the bottom of said inhaling body.

8. An inhaling unit substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawings.

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